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By John R. Bartels

UNITED STATES DEPARTMENT OF THE INTERIOR

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UNITED STATES DEPARTMENT OF THE INTERIOR
Donald Paul Hodel, Secretary

BUREAU OF MINES
Robert C. Horton, Director

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

cu ft	cubic foot	min	minute
ft	foot	psi	pound per square inch
gal	gallon	s	second
in	inch	yr	year
lb	pound		

IMPROVED UNDERGROUND RERAILING APPARATUS

By John R. Bartels [1]

ABSTRACT

This report discusses an improved method for rerailing underground railcars devised in a joint effort by the Bureau of Mines and Hoesch MFD. This improved method utilizes a lightweight hydraulic ram with hand-pump activation to move a bridge-mounted roller carriage in conjunction with steel-reinforced air-lift bags. This method provides a lightweight portable system in which only two workers are required to perform the mine car rerailing operation. Because of the very narrow confines in underground mines, use of overhead cranes and other surface rail techniques is not possible. This new system is designed for very low profile work, and provides the necessary lifting force from lightweight compressed-air bottles.

[1]Civil engineer, Pittsburgh Research Center, Bureau of Mines, Pittsburgh, PA.

INTRODUCTION

A serious mine operational problem has been the dangerous task of rerailing mine cars after accidents and frequent track "hopping." The current practice for rerailing mine cars is extremely hazardous and inefficient. Rerailing devices in use include commercial roll-on plates and hand jacks. In some cases, methods involving wooden props and pry bars are employed. The disadvantages of these methods can be listed as follows:

1. Most current methods require pulling the derailed car with a locomotive back onto the track, with resultant damage to the road bed. This method is not effective on curves and situations where the wheels are too far from each rail.

2. Jacks require extensive raising and lowering of cars, block supporting, and leveling to manipulate the cars back onto the track. The method requires very strenuous manual effort. The close confines in a mine makes this an extremely hazardous procedure to the workers doing the rerailing.

3. The use of wooden props involves wedging and jamming of wood ties between the mine rib and car, and then pulling the car with the locomotive. The purpose is to generate a thrust component in a direction that will lift the car back onto the track. This method is extremely dangerous in that actual thrust components generated are unpredictable and unstable.

The surface rail industry, which constitutes the majority of rail equipment and equipment development, does not have the peculiar rerailing problems of underground rail systems. This is due to the accessibility by rail-mounted or tire-mounted lifting cranes for correcting derailments. There is not sufficient headroom in mine entries to permit crane rerailment. When surface derailment occurs in tunnels, roll-up plates and jacks, similar to those used in underground situations are utilized, but these occurrences are not frequent enough to cause much concern.

The extent of the problem can be seen by the number of injuries sustained by mine personnel while engaged in rerailing operations during the past 5 yr:

1978.....	129	1981.....	136
1979.....	189	1982.....	138
1980.....	227		

The frequency of derailments and the large number of injuries associated with them indicate that improving the current rerailing methods would not only reduce accidents but also improve overall mine efficiency.

It is believed that this project has resulted in a device that can be easily carried by workers into the mine in parts and assembled at the site of the derailment. Furthermore, it can be hydraulically and pneumatically powered, rather than manually operated, to provide the lifting and sliding forces necessary to quickly perform the rerailing operation.

SYSTEM REQUIREMENTS

Recognizing the hazards of underground rerailing, the Bureau set out to identify the requirements for a safe system to be used in underground mines. These requirements are listed as follows:

1. Each piece of equipment must be capable of being carried by no more than two people with a load limit of 60 lb for any one person.

2. The equipment must be capable of providing the lifting and positioning forces without requiring strenuous effort from the worker.

3. The equipment must be capable of utilizing local power sources or providing its own power source.

4. It must be very low profile to enable working in the narrow confines between mine floor and car bottom.

5. It must be rugged enough to handle the harsh underground environment.

6. It must be simple and safe to operate.

7. It must be low cost.

8. It must be easily field serviced.

With these requirements in mind, a search was made of commercial suppliers of rerailing equipment. No domestic supplier could be found, but the West German company Hoesch MFD had available some promising equipment that had been in use with the European light rail industry. Contact with the company officials indicated that they would be interested in helping tailor this apparatus for use in underground mines.

SYSTEM DESCRIPTION

By combining two previously unrelated technologies currently in use by the surface mining and rail industries, a system was developed to rerail underground track vehicles using a safe, simple, and reliable method. The technologies used are steel reinforced rubber air-lift bags, manufactured by Vetter Engineering,[2] and a hydraulically activated roller system, manufactured by Hoesch MFD, that has been scaled down to accommodate the confined mining environment. This combination raises the derailed car onto a roller mechanism and centers the car back on the track without the strenuous physical effort or hazardous uncertainty of conventional methods.

The rerailing system (fig. 1) consists of the following:

1 roller carriage, 16.5-ton carrying capacity (78 lb).

1 oil hydraulic displacing jack with screw-type couplers, 11-in displacement, and 6.6-ton capacity (17 lb).

1 steel countersupport, light construction (17 lb).

1 auxiliary hand pump, 29- by 9.6-in base, 11 in high, with 2.1-gal oil

[2]Reference to specific manufacturers and equipment does not imply endorsement by the Bureau of Mines.

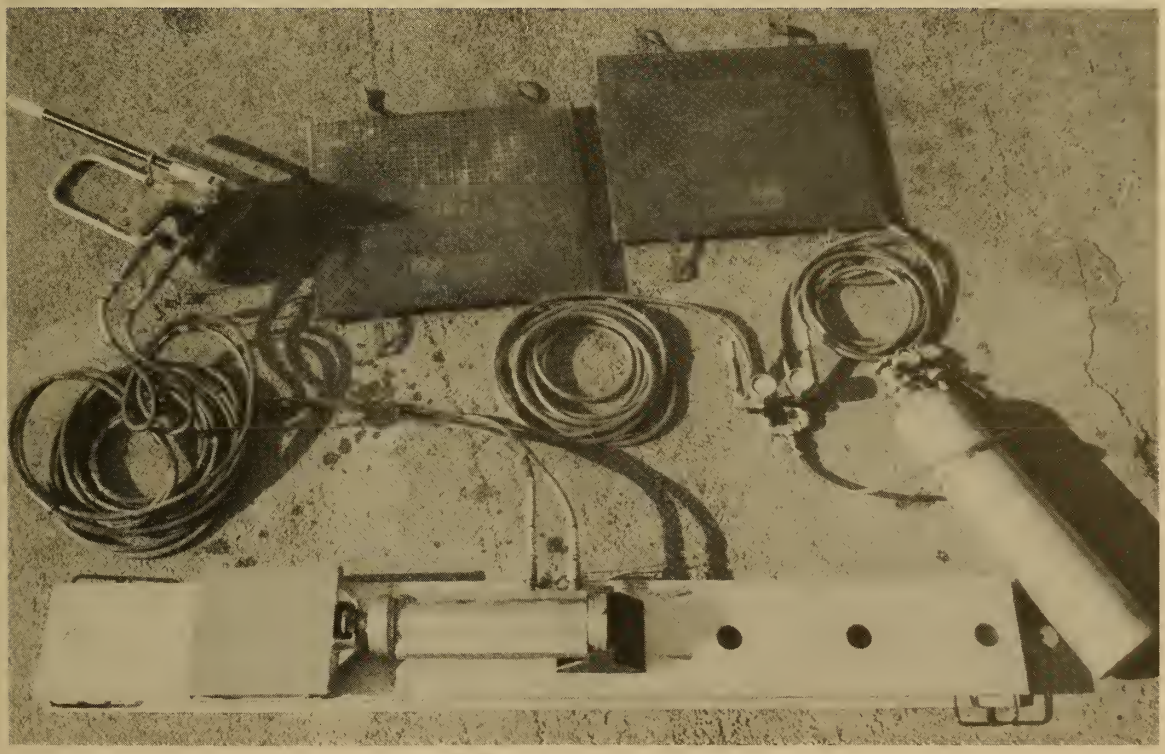

FIGURE 1. - System components.

container, integral 4-way valve, and 4,000-psi pressure (55 lb).

1 pair hydraulic hoses, 16 ft long, with screw-type couplers (26 lb).

1 rerailing bridge, low profile, 7 ft long, 3-3/4 in high (81 lb).

2 airbags, 30.3 in by 26.8 in each, 1-in collapsed height, 30 cu ft at 90-psi maximum (40.5 lb each).

1 dual-control safety unit. (6.3 lb).

1 pressure regular, manually adjustable to 90 psi (3.7 lb).

2 safety pressure hoses, 16 ft 4 in each, 1 clear and 1 green (2 lb each).

2 safety pressure hoses, 32 ft 8 in each, 1 clear and 1 green (3.2 lb each).

1 railway connector (2 lb).

2 portable compressed-air bottles, 80 cu ft each (31.4 lb each).

The rerailing system is compact and weighs 440.2 lb. Rerailing is safely accomplished by a crew of two in less than 15 min. The system is low profile and should be effective in the lowest coal seams. The air-lift-bag system allows the lifting mechanism to be placed to balance any off-center loadings. The operation of the equipment is simple and should require little operator training. Rerailing can be accomplished effectively on all mine track vehicles up to 30 tons gross weight under typical rerailing conditions, including derailments on curves and derailments up to 5 ft away from the track, that are too far off the track for conventional rerailing techniques to handle effectively.

FIGURE 2. - Placement of air-lift bags.

RERAILING PROCEDURE

The first step in rerailing a vehicle is to place a pair of steel-reinforced rubber air-lift bags under the vehicle (fig. 2). Because these air-bags are collapsible to 1 in, they can be slid under rail equipment. The airbags are inflated using lightweight (aluminum) portable compressed-air bottles or any other convenient compressed-air source. The airbags easily lift a 30-ton car above the tracks so that rerailing can commence (fig. 3).

Next, a low-profile lightweight (aluminum) bridge is placed across the tracks. A roller carriage and bidirectional hydraulic ram connected by the hydraulic lines to the auxiliary hand pump are attached to the bridge using a steel countersupport (fig. 4). Crib blocks are set on the roller carriage to support the vehicle at the desired height above the rails (fig. 5).

The airbags now can be deflated lowering the vehicle onto the roller carriage. The vehicle is then centered on the track by the use of an auxiliary hydraulic hand pump (fig. 6), which activates the bidirectional ram.

When the vehicle has been centered on the track, the airbags are inflated to raise the vehicle off the roller, and the rerailing equipment removed. Finally, the airbags are deflated and removed. The entire rerailing operation is safe and simple.

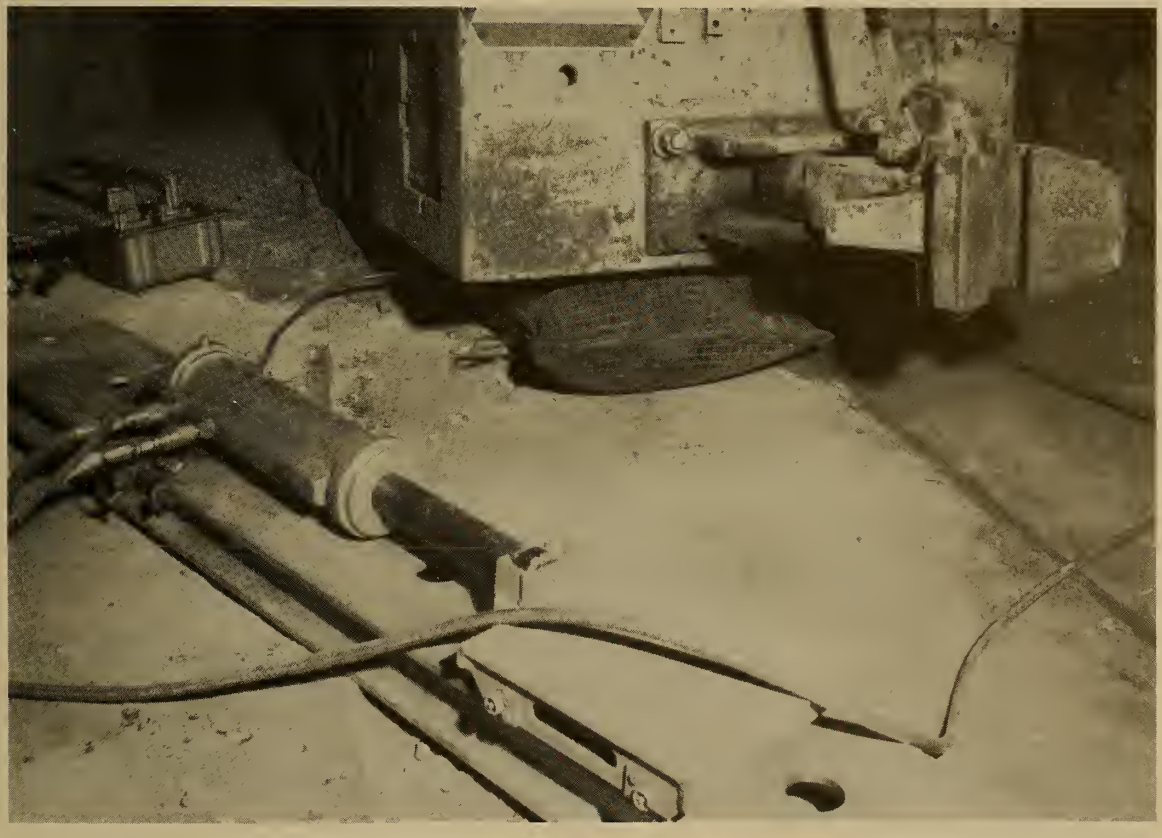

FIGURE 3. - Raising car above track.

FIGURE 4. - Placement of bridge and roller carriage.

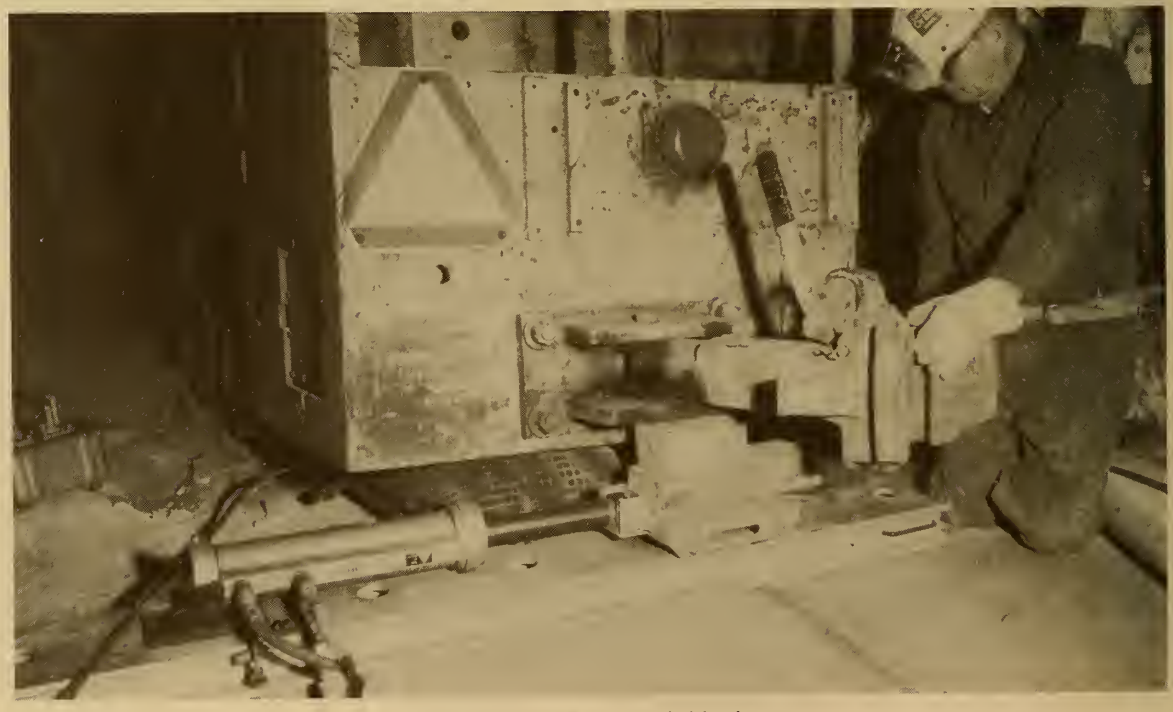

FIGURE 5. - Setting crib blocks.

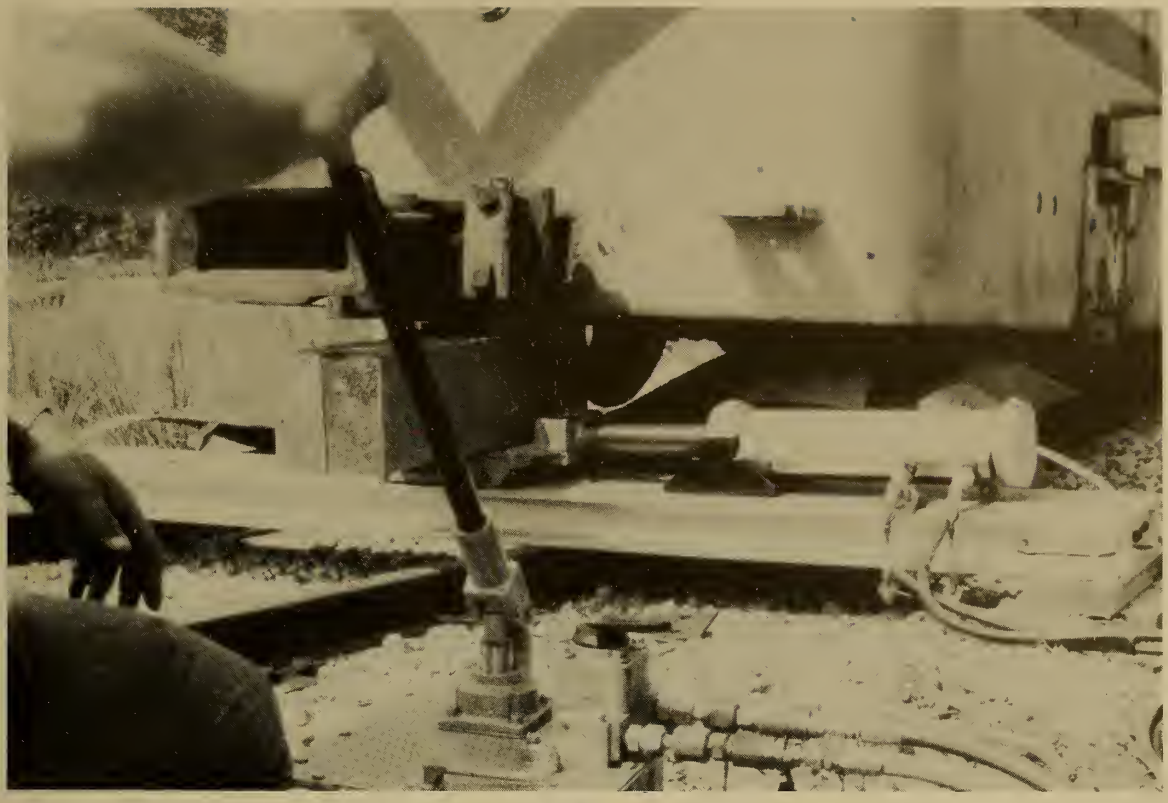

FIGURE 6. - Centering car on track.

TIME TRIALS

Underground time trials utilizing the improved rerailing apparatus were conducted at the Bureau's Safety Research Coal Mine (Bruceton, PA). A diesel locomotive was derailed on a straightaway and on a curve. Two separate crews that had received a 5-min training session on the equipment were asked to rerail the locomotive under both sets of derailed conditions. The average time to unload the equipment from a transport vehicle, unpack the equipment, rerail the vehicle, and then repack and load was about 15 min for each crew. The fact that one of the test conditions was on a curve, a situation that would present serious problems using conventional underground rerailing techniques, made little difference in either time required to complete the rerailing or the difficulty of the task. The average times for the rerailing operation were as follows:

Unload.....	3 min 35 s
Rerail locomotive.....	7 min
Repack equipment.....	4 min 17 s

The tests were repeated with a new crew using the Bureau's surface rail facility and a 16-ton electric locomotive. Tests results were similar to those for the first series:

Unload equipment.....	4 min
Rerail locomotive.....	7 min 15 s
Repack equipment.....	3 min 50 s

All tests ran smoothly with no special problems or equipment failure. The equipment seems to be universally adaptable to most types of underground rail vehicles. The rerailing equipment operation is simple enough that mine personnel should have no operational problems in implementing this system.

CONCLUSIONS

Implementation of the improved rerailing system will dramatically improve the efficiency and safety of underground rerailing operations. Current methods of rerailing using roll-on plates and crib blocks are so manually intensive and hazardous that the industry should be quite receptive to this improved method. It is safe, simple, and reliable, and the equipment is easily transported and used by two people with only minimal training. Under test conditions, the entire rerailing operation was accomplished in approximately 15 min. The system is currently available as a package from Railquip Inc. This system, with minor modifications, or a similar system based on the data specified in the section "System Requirements" should be adaptable to most underground mining environments.

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